**SPEED CONTROL OF DC MOTOR BY USING PWM TECHNIQUE**

**ABSTRACT**

The project reveals the digital closed loop control system for speed control of DC motor using PWM technique. In present days the power semiconductor devices have completely revolutionized the control of drives especially in the area of control usage of thyristors igbt’s power MOsFET etc., was increased

The digital circuit can be interfaced to microcontroller. So that the speed can be controlled by Microcontroller there by making speed control of DC motor even more easily. Pwm technique to the digital circuit drives the component correspondingly speed will change .

The project basically consists of micro controller MCS 51 series 89c52 and motor driver, thermal sensor, comparator, key pad,16X2 dot matrix LCD display and rotation feedback sensor (optical encoder). The program is written in micro controller to take the input values from the user, then rotates the motor by placing 50% duty cycle pulse on the motor. The motor is rotated at X RPM speed, can be detected by using feedback sensor and micro controller. If the speed is above the specified speed then the micro controller continuously reduces the duty cycle till the speed comes to a predetermined level. If the detected speed is less than the pre determined speed then the micro controller continuously increases the duty cycle till the determined level. The micro controller keeps on tracking the determined speed by varying duty cycle in a closed loop control system.

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**INTRODUCTION**

**INTRODUCTION**

Today’s industries are increasingly demanding process automation in all sectors. Automation results into better quality, increased production an reduced costs. The variable speed drives, which can control the speed of A.C/D.C motors, are indispensable controlling elements in automation systems. Depending on the applications, some of them are fixed speed and some of the variable speed drives.

The variable speed drives, till a couple of decades back, had various limitations, such as poor efficiencies, larger space, lower speeds, etc., However, the advent power electronic devices such as power MOSFETs, IGBTs etc., and also with the introduction of micro -controllers with many features on the same silicon wafer, transformed the scene completely and today we have variable speed drive systems which are not only in the smaller in size but also very efficient, highly reliable and meeting all the stringent demands of various industries of modern era.

Direct currents (DC) motors have been used in variable speed drives for a long time. The versatile characteristics of dc motors can provide high starting torques which is required for traction drives. Control over a wide speed range, both below and above the rated speed can be very easily achieved. The methods of speed control are simpler and less expensive than those of alternating current motors.

There are different techniques available for the speed control of DC motors. The phase control method is widely adopted, but has certain limitations mainly it generates harmonics on the power line and it also has got p .f when operated lower speeds. The second method is pwm technique, which has got better advantages over the phase control.

In the proposed project, a 5 H.P DC motors circuitry is designed, and developed using pulse with modulation (PWM).The pulse width modulation can be achieved in several ways. In the present project, the PWM generation is done using micro- controller.

In order to have better speed regulation, it is required to have a feedback from the motor. The feedback can be taken either by using a tachogenerator or an optical encoder or the back EMF itself can be used .In present project, we implemented the feedback by using the EMF of the armature as the feedback signal.

The project proposed is a real time working project, and this can be further improvised by using the other safety features, such as field current, air gap magnetic flux, armature current, etc.,

1. **DC MOTOR**

**1. DC MOTOR**

**1.1 INTRODUCTION TO SPEED CONTROL:**

Speed control means intentional change of drive speed to a value required for performing the specific work process. This concept of speed control or adjustment should not be taken to include the natural change in speed which occurs due to change in the load on the shaft.

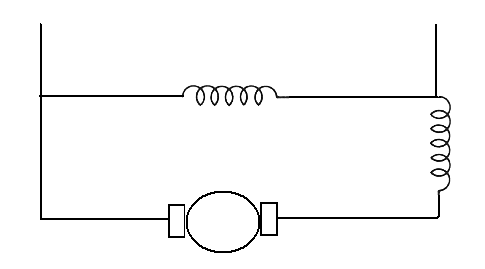
Any given piece of industrial equipment may have its speed change or Adjusted mechanically by means of stepped pulleys, sets of change gears, variable speed friction clutch mechanism and other mechanical devices. Historically it is proved to be the first step in transition from non adjustable speed to adjustable speed drive. The electrical speed control has many economical as well as engineering advantages over mechanical speed control

The nature of the speed control requirement for an industrial drive depends upon its type. Some drives may require continues variation of speed for the whole of the range from zero to full speed or over a portion of this range , while the others may require two or more fixed speeds

**1.2 CLASSIFICATION OF DC MOTORS:**

DC motors are classified into three types depending upon the way their field windings are excited. Field windings connections for the three types Of DC motors have been shown in figure

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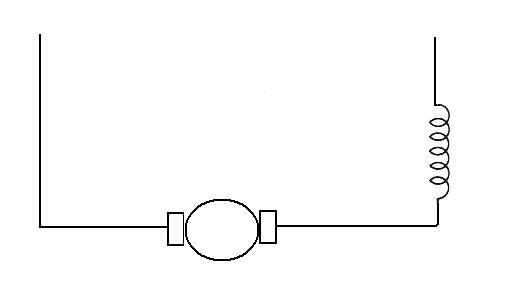


**SHUNT MOTOR**

**Saturating field**

**V**

**M**

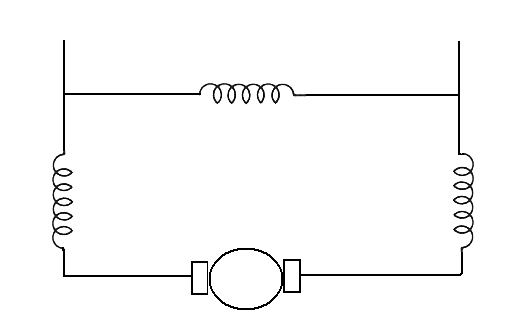


**SERIES MOTOR**

**M**

**V**

**Series field**



**Series field**

**M**

**V**

**Shunt field**

**COMPOUND MOTOR**

**Fig.1.1 Classification of DC Motor**

**1.3 SPEED CONTROL OF DC MOTORS:**

The DC motors are in general much more adaptable speed drives than AC motors which are associated with a constant speed rotating field. Indeed one of the primary reasons for the strong competitive position of DC motors in modern industrial drives is the wide range of specified afforded we know the equation

N= K (ϕ)

=K (V-Ia Ra / ϕ)

Where V=supply voltage (volts)

Ia = armature current (amps)

Ra=armature resistance (ohms)

Φ=flux per pole (Weber)

This equation gives two methods of effective speed changes.i.e.

1. The variation of field excitation, if this causes in the flux per pole Φ and is known as the field control.
2. The variation of terminal voltage (V).this method is known as armature control.

**1.4 SPEED CONTROL OF SHUNT MOTOR**

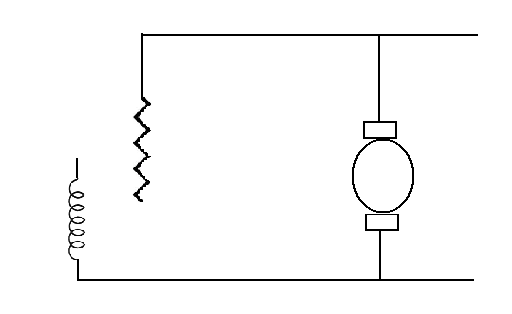
**1.4.1 FLUX CONTROL METHOD:**

It is known that Nα1/ Φ by decreasing the flux, the can be increased and vice versa. Hence, name flux or field control method.

The flux of DC motor can be changed by changing with help of a shunt field rheostat. Since in relatively small, shunt field rheostat has to carry only a small, so that rheostat is small in size. This method therefore very efficient in non-interpolar machines the speed can be increased by this method in the ratio 2:1 any further weakening of flux Φ adversely affect the communication

And hence puts a limit to the maximum speed obtainable with this method in machines fitted with interlopes in ratio of maximum to minimum speeds of 6:1 is fairly common.

The connection diagram for this type of speed control is shown in figure below.

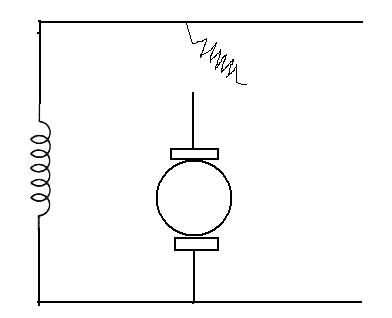


V

**Field rheostat**

**Fig.1.2 Flux Control Method**

**1.4.2 ARMATURE OR RHEOSTAT CONTROL METHOD:**

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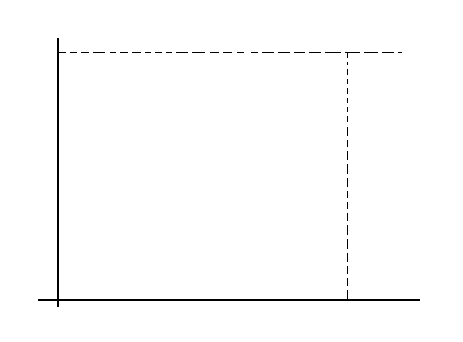
**Field**

V

Ia

**Controller**

**Resistance**

****

Speed,N

Armature current, Ia

Ristence in

armature

armaturein

**Fig 1.3**

**Rheostat Control Method and Characteristics**

This method is used when speeds below the no load speed are required. As the supply voltage is normally constant, the voltage across the armature is varied by inserting a variable rheostat or controller resistance in series with the armature circuit as shown in fig. as controller resistance is increased, potential difference across the armature is decreased, thereby decreasing the armature speed. For a load of constant torque, speed is approximately proportional to the potential difference.

Across the armature current characteristics in fig. in seen that greater the resistance

In the armature circuit, greater is the fall in speed

Let

Ia1 = Armature current in the first case

Ia2 = Armature current in the second case

N1, N2 = corresponding speeds

V = Supply voltage

Then N1(v-Ia1Ra )αEb1

Let some controller resistance of value R be added to the armature circuit resistance so that its value becomes

(R+Ra) = Rt

Then

N2 α (V-Ia2 Rt) α Eb2

N2/N1=Eb2/Eb1

Considering no load speed, we have

N/N0 (I-(Ia Rt)/ (V-Ia0 Ra)

Neglecting Iao Ra w.r.t.toV, we get

N=No (I-(Ia Rt)/ V

**Speed, N**

**No**

**Ia**

**Im**

**Fig.1.4**

It is seen that for a given resistance Rt the speed is a linear function of armature current Ia as shown in fig.

The load current for which the speed would be zero is found by putting N=0 in above relation

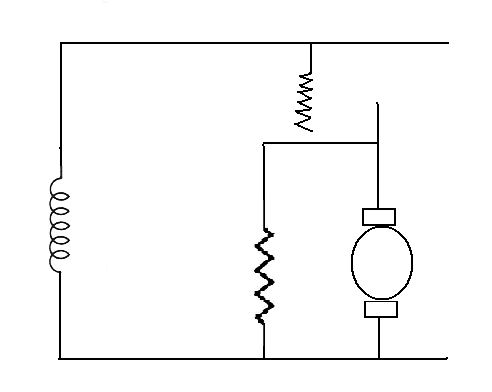
0 = N0 ((I-Ia Rt)/V)

Or

Ia = V/Rt

This maximum current and is known as stalling current. This method is very wasteful, expensive and unsuitable for rapidly changing loads because for a given value of Rt, speed will change with load. A more stable operation can be obtained by using a diverter across the armature in addition to armature control resistance.

Now, the changes in armature current will not be so effective in changing the potential difference across the armature. The connection diagram for this type of speed control arrangement is shown in fig.



Series resistence

Diverter

Shunt field

Motor

**Fig.1.5 Armature Control Method**

**1.4.3 VOLTAGE CONTROL METHOD:**

1. **MULTIPLE CONTROL VOLTAGE :**

In this method, the shunt field of the motor is connected permanently to a fixed exciting voltage but the armature is supplied with different voltages by connecting it across one at the several different voltages by means of suitable switchgear. The armature will be approximately proportional to these different voltages. The intermediate speeds can be obtained by adjusting the shunt field regulator.

**B) WARD-LEONARD SYSTEM:**

This system is used where an unusually wide (upto 10:1) and very sensitive speed control is required as for colliery winders , electric excavators and the main drives in steel mills and blooming in paper mills.

The field of the motor (M1) whose speed control is permanently connected across the DC supply lines. The other motor M2 is directly connected to Generator G.

The output voltage of G is directly is fed to the main motor M1. The voltage of generator can be varied from zero to upto its maximum value by means of field regulator. By reversing the direction of the field current of G by means of the reversing switch which RS, generated voltage can be reversed and hence the direction of rotation of M1. It should be remembered that motor set always runs in the same direction.

A modification of the word –Leonard system is known as word –Leonard -linger system which uses a smaller motor generator set with

The addition of a flywheel whose function is to reduce fluctuations in the Power demand from the supply circuit .

The chief advantage of system is its overall efficiency especially at right loads. It has the outstanding merit of giving wide speed Control from maximum in one direction through zero to the maximum in the opposite direction and of giving a smooth acceleration.

**1.5 MOTOR APPLICATIONS:**

DC motor possesses excellent torque speed characteristics and offer a wide range of speed control. Though efforts are being made to obtain wide range speed control with ac motors, yet the versatility and flexibility of a dc motors can’t be matched by a ac motors.

In view of this, the demand for dc motors would continue undiminished even in figure. A brief discussion regarding the dc motor applications is given below.

**1.5.1 SHUNT MOTORS:**

* For a given field current in a shunt motor, the speed drop from no load to full load is invariably less than 6% t o 8%. In view of this, the shunt motor is termed a constant speed motor. Therefore for constant speed drives in industry, dc shunt motor’s can be employ. But this motor can’t complete with constant speed squirrel cage induction motor, because the latter cheaper, rugged and requires less maintenance.
* When constant speed service at low speeds is required, the comparison is usually between synchronous motors and dc shunt motors. It is because the construction of high performance poly phase induction motor with large number of poles is difficult. However, for adjustable speed service at low operating speed, dc shunt motor is a preferred choice
* When the driven load requires a wide range of speed control (both below base speed and above base speed), a dc shunt motor is employed, e.g. .in latches etc.

**1.5.2 SERIES MOTORS**

The outstanding feature of series motor is the automatic decrease in speed as soon as increased load torque is required. The decreasing speed with increase in load torque or vice versa has only a marginal effect on the power taken by the series motor.

* Since a series motor can withstand severe starting duties and can furnish high starting torques , it is best suited for driving hoists, trains , excavators ,cranes, etc. wound motor induction motors compete favorably with series motor’s ,but the choice is governed by the economics . However for traction purposes , series motor is the only choice. Therefore series motors are widely used in all types of electric vehicles, eletrictrains, streetcars, battery powered tools, automotive starter motors etc.
* Series motors can be used to drive permanently connected loads, such as fan load, because their torque requirement increases with the square of the speed
* In order to avoid the pollution in big cities, now battery driven automobiles are being introduced on a large scale.

**1.5.3 COMPOUND MOTORS**

A compound motor with a strong series field has its characteristics approaching that of a series motor. Therefore such type of compound motors are used for loads requiring heavy starting torque which are likely to be reduced to zero

A compound motor with weak series field has its characteristics approaching that of a shunt motor. Weak series field causes more drooping speed torque characteristics than with an ordinary shunt motors. Such compound motors with steeper characteristics, are used where load fluctuates between wide limits intermittently.

**2.SWITCHING DEVICES**

**PWM TECHNIQUES**

**2. SWITCHING DEVICES AND PWM TECHNIQUE**

**2.1 POWER SEMICONDUCTOR DEVICES CLASSIFICATION:**

**Power semiconductor devices**

**3 Terminal devices**

**2 Terminal devices**

**Schotkey diode**

**PN Diode**

**IGBT**

**Thyristor**

**JFET**

**Power MOSFET**

**BJT**

**Fig.2.1. Classification of Switching Devices**

Today’s power semiconductor devices are almost exclusively based on silicon material and can be classified as follows:

**•** Diode

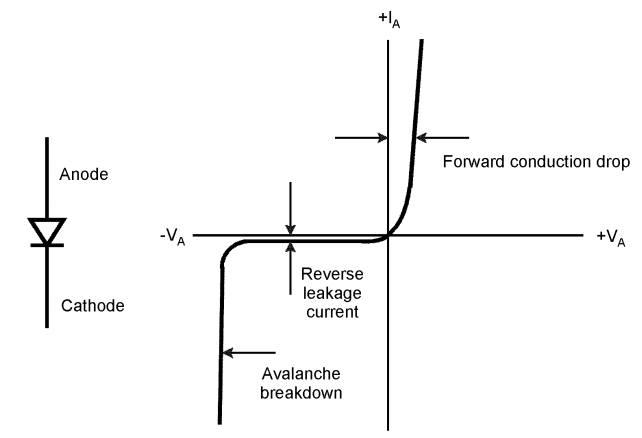
**•** Thyristor or silicon-controlled rectifier (SCR)

**•**Bipolar junction transistor (BJT)

**•** Power MOSFET

**2.2 DIODE:**

Power diodes provide uncontrolled rectification of power and are used in applications such as electroplating, anodizing, battery charging, welding, power supplies (dc and ac), and variable frequency drives. They are also used in feedback and the freewheeling functions of converters and snubbers. Shows the diode symbol and its volt-ampere characteristics. In the forward biased condition, the diode can be represented by a junction offset drop and a series-equivalent resistance that gives a positive slope in the V-I characteristics. The typical forward conduction drop is 1.0 V. This drop will cause conduction loss, and the device must be cooled by the appropriate heat sink to limit the junction temperature. In the reverse-biased condition, a small leakage current flows due to minority carriers, which gradually increase with voltage. If the reverse voltage exceeds a threshold value, called the breakdown voltage, the device goes through avalanche breakdown, which is when reverse current becomes large and the diode is destroyed by heating due to large power dissipation in the junction.

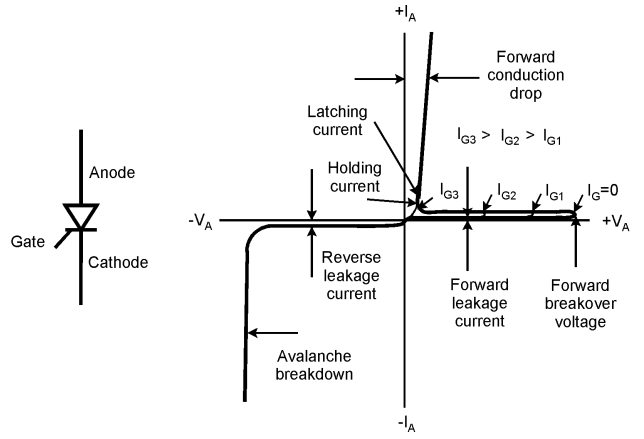


**Fig.2.2.Symbol & Characteristics of Diode**

**2.3 THYRISTORS:**

Thyristors or silicon-controlled rectifiers (SCRs) have been the traditional workhorses for bulk power conversion and control in industry. The modern era of solid-state power electronics started due to the introduction of this device in the late 1950s. Basically, it is a trigger into conduction device that can be turned on by positive gate current pulse but once the device is on, a negative gate pulse cannot turn it off. The device turn on process is very fast and turn off process is slow because the minority carriers are to be cleared from the inner junctions by “recovery and recombination” processes

Commercial thyristors can be classified as phase control and inverter types. The thyristors have been widely used in dc and ac drives, lighting, heating and welding control.



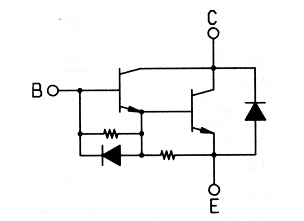
**Fig.2.3. Diode symbol and V-I characteristics**

**2.4 BIPOLAR POWER OR JUNCTION TRANSISTORS**

**(BPTS OR BJTS)**

A bipolar junction transistor (BJT), unlike a thyristor-like device, is a two-junction, self-controlled device where the collector current is under the control of the base drive current. Bipolar junction transistors have recently been ousted by IGBTs (insulated gate bipolar transistors) in the higher end and by power MOSFETs in the lower end. The dc current gain (*hFE*) of a power transistor is low and varies widely with collector current and temperature. The gain is increased to a high value in the Darlington connection, as shown in Figure However, the disadvantages are higher leakage current, higher conduction drop, and reduced switching frequency.

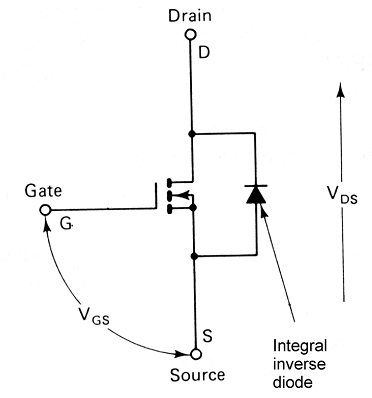
The shunt resistances and diode in the base-emitter circuit help to reduce collector leakage current and establish base bias voltages. A transistor can block voltage in the forward direction only (asymmetric blocking). The feedback diode, as shown, is an essential element for chopper and voltage-fed converter applications. Double or triple Darlington transistors are available in module form with matched parallel devices for higher power rating. Power transistors have an important property known as the second breakdown effect. This is in contrast to the avalanche breakdown effect of a junction, which is also known as first breakdown effect. When the collector current is switched on by the base drive, it tends to crowd on the base-emitter junction periphery, thus constricting the collector current in a narrow area of the reverse-biased collector junction. This tends to create a hot spot and the junction fails by thermal runaway, which is known as second breakdown. The rise in junction temperature at the hot spot accentuates the current concentration owing to the negative temperature coefficient of the drop, and this regeneration effect causes collapse of the collector voltage, thus destroying the device.



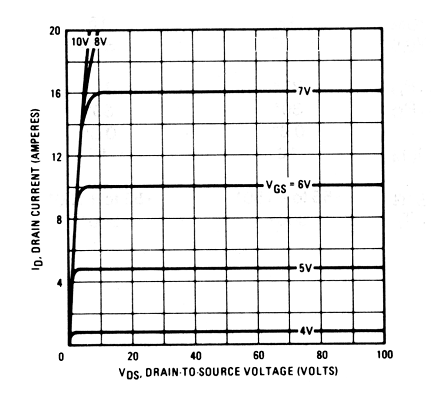
**Fig.2.4. Two stage Darlington transistor with bypass diode**

**2.5 POWER MOSFETS:**

Unlike the devices discussed so far, a power MOSFET (metal-oxide semiconductor field effect transistor) is a unipolar, majority carrier, “zero junctions,” voltage-controlled device. (a) shows the symbol of an N-type MOSFET and (b) shows its volt-ampere characteristics. If the gate voltage is positive and beyond a threshold value, an N-type conducting channel will be induced that will permit current flow by majority carrier (electrons) between the drain and the source. Although the gate impedance is extremely high at steady state, the effective gate-source capacitance will demand a pulse current during turn-on and turn-off. The device has asymmetric voltage-blocking capability, and has an integral body diode, as shown, which can carry full current in the reverse direction. The diode is characterized by slow recovery and is often bypassed by an external fast-recovery diode in high-frequency applications.

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**Fig.2.5.Power MOSFET Symbol**

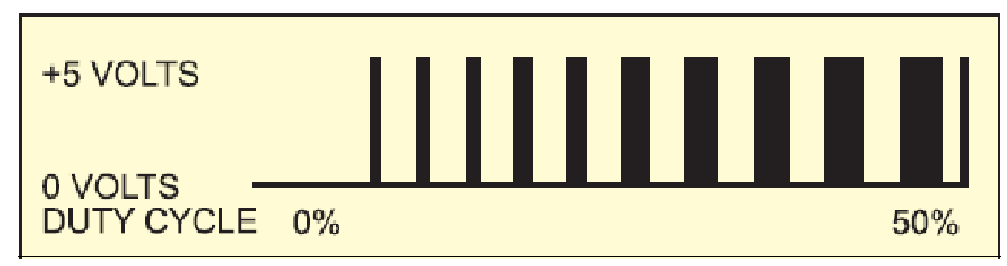
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**Fig.2.6. V-I characteristics of power MOSFET**

**2.6 PWM TECHNIQUE:**

**2.6.1 Introduction:**

Pulse-width modulation (PWM) or duty-cycle variation methods are commonly used in speed control of DC motors. The duty cycle is defined as the percentage of digital ‘high’ to digital ‘low’ plus digital ‘high’ pulse-width during a PWM period.



**Fig.2.7. 5V Pulses With 0% Through 50% Duty Cycle**

Fig.1 shows the 5V pulses with 0% through 50% duty cycle. The average DC

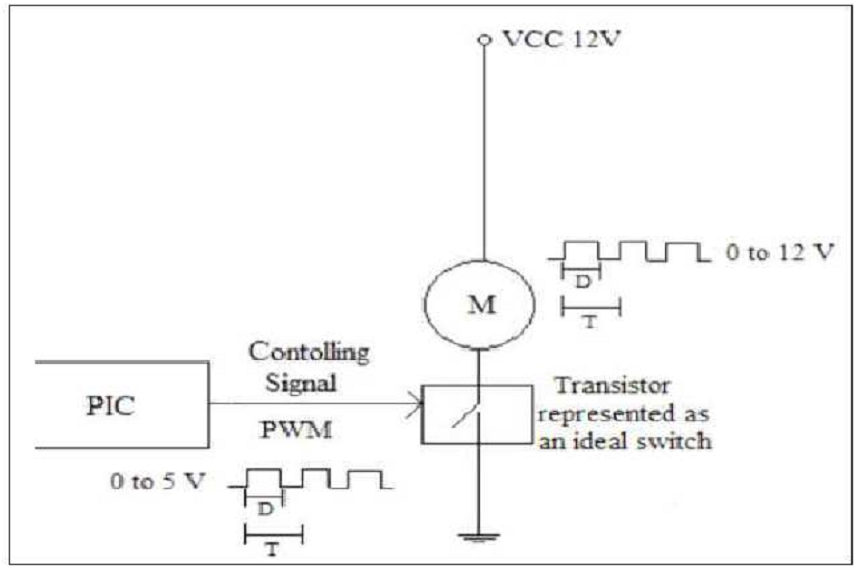
Voltage value for 0% duty cycle is zero; with 25% duty cycle the average value is 1.25V (25% of 5V). With 50% duty cycle the average value is 2.5V, and if the duty cycle is 75%, the average voltage is 3.75V and so on. The maximum duty cycle can be 100%, which is equivalent to a DC waveform. Thus by varying the pulse-width, we can vary the average voltage across a DC motor and hence its speed. The average voltage is given by the following equation:

ý = D. Ymax + (1- D) Ymin

But usually minimum equals zero so the average voltage will be:

ý = D. Ymax

The circuit of a simple speed controller for a mini DC motor, such as that used in tape recorders and toys, is shown in Fig



**Fig.2.8. DC motor speed control using PWM method**

1. Write an assembly program to generate a PWM with a frequency of 1 kHz and a duty cycle of 50%, and watch your signal on the oscilloscope.
2. Now connect your signal to the motor driver.

The major reason for using pulse width modulation in DC motor control is to avoid the excessive heat dissipation in linear power amplifiers. The heat dissipation problem often results in large heat sinks and sometimes forced cooling. PWM amplifiers greatly reduce this problem because of their much higher power conversion efficiency. Moreover the input signal to the PWM driver may be directly derived from any digital system without the need for any D/A converters.

The PWM power amplifier is not without disadvantages. The desired signal is not translated to a voltage amplitude but rather the time duration (or duty cycle) of a pulse.

This is obviously not a linear operation. But with a few assumptions, which are usually valid in motor control, the PWM may be approximated as being linear (i.e., a pure gain).The linear model of the PWM amplifier is based on the average voltage being equal to the integral of the voltage waveform. Thus

VS \* Ton = Veq \* T

Where

VS = the supply voltage (+12 volts)

Ton = Pulse duration

Veq = the average or equivalent voltage seen by the motor

T = Switching period (1/f)

The recommended switching frequency is 300Hz.

The switching frequency (1/T), is determined by the motor and amplifier characteristics.

The control variable is the duty cycle which is Ton / T. The duty cycle must be

recalculated at each sampling time. The voltage that the motor sees is thus Veq, which is equal to the duty cycle times the supply voltage.

**2.6.2 Principle**

Pulse width modulation control works by switching the power supplied to the motor on and off very rapidly. The DC voltage is converted to a square wave signal, alternating between fully on (nearly 12v) and zero, giving the motor a series of power “kicks”.

Pulse width modulation technique (PWM) is a technique for speed control which can overcome the problem of poor starting performance of a motor.

PWM for motor speed control works in a very similar way. Instead of supplying a varying voltage to a motor, it is supplied with a fixed voltage value (such as 12v) which starts it spinning immediately. The voltage is then removed and the motor ‘coasts’. By continuing this voltage on/off cycle with a varying duty cycle, the motor speed can be controlled.

The wave forms in the below figure to explain the way in which this method of control operates. In each case the signal has maximum and minimum voltages of 12v and 0v.

* In wave form, the signal has a mark space ratio of 1:1.with the signal at 12v for 50% of the time, the average voltage is 6v, so the motor runs at half its maximum speed.
* In wave form, the signal has mark space ratio of 3:1.which means that the output is at 12v for 75% of the time. This clearly gives an average output voltage of 9v, so the motor runs at 3/ 4 of its maximum speed.
* In wave form, the signal has mark space ratio is 1:3, giving an output signal that is 12v for just 25% o the time. The average output voltage of this signal is just 3v, so the motor runs at 1/4 of its maximum speed.

By varying the mark space ratio of the signal over the full range, it is possible to obtain any desired average output voltage from 0v to12v .The motor will work perfectly well, provided that the frequency of the pulsed signal is set correctly, a suitable frequency being 30Hz.setting the frequency too low gives jerky operation. and setting it too high might increase the motor’s impedance.

1:1 Mark space ratio (50% duty cycle)

3:1 Mark space ratio (75% duty cycle)

1:3Mark space ratio (25%dutycycle)

**Fig.2.9. Pulse Width Modulation Waveforms**

**2.6.3 METHODS**

The pwm signals can be generated in a number of ways. there are several methods:

* analogue method
* digital method
* discrete IC
* On board micro controller

**Analogue method:**

A block diagram of an analogue PWM generator is

Triangle wave generator

from radio

control receiver

PWM

comparator

receiver signel to demand signel converter

**Fig.2.10.** **Block Diagram Of An Analogue Pwm Generator**

The simplest way to generate a PWM signal is the intersective method, which requires only a saw tooth or a triangle wave form (easily generated using a simple oscillator) and a comparator. When the value of the reference signal is more than the modulation wave form, the PWM signal is in the high state, otherwise it is in the low state.

**Digital Method:**

The digital method involves incrementing a counter, an comparing the counter value with a pre-loaded register value, or value set by an ADC. Thy normally us a counter that increments periodically and is reset at the end very period of the PWM. When the counter value is more than the reference value, the PWM output changes state from high to low.

**PWM generator chips:**

There are several Ic’s available which converts a DC level into a PWM output. many of these are designed for use in switch mo power supplies .unfortunately, the devices designed for switch mode power supplies not to allow the mark-space ratio to alter over the entire 0 – 100% range. many limit the maximum to 90% which is effectively limiting the power you can send to the motors. devices designed as pulse generators should allow the whole range to be used.

**Onboard micro controller:**

A micro controller on the robot, this may be able to generate the wave form, although if you have a more than a couple of motors, this may be too much of load on the micro controllers resources. So if you have chosen to use an on board micro controller, then as part of you selection process, include whether it has PWM outputs .if it has this can greatly simplify the process of generating signals.

**3. COMPONENTS DESCRIPTION**

**3. COMPONENTS DESCRIPTION**

**3.1 INTRODUCTION:**

The main aim of the dc motor speed control using pwm is after power on the power supply generates +5v dc ,+12v dc ,the logic section works on +5v dc and the motor and motor driven sections are working on +12v dc .the explanations of the power supply is given in the power supply module.

After power on the micro controller generates oscillations at the rate of 11.059-12Mhz.frequency sine wave i.e. internally converted into square wave with the help of internal oscillator. The oscillator section is given bellowing the oscillator module

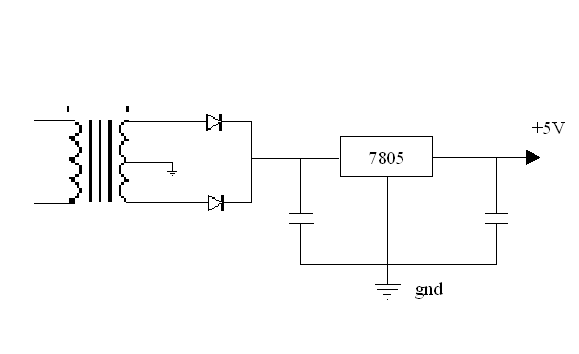
The reset logic generates the reset signal are applied at the rxd pin of the micro controller. The exploitation of the reset logic is given below. After reset he micro controller starts executing program on the memory location program area 0000h.initially the micro controller initializes the LCD display connected to the port0, port2.7, port2.6, port2.5. Sub sequentially the mc displays the “set speed” i.e. required Speed to rotate the information must be feeded through 3 switches connected to the port1; the 3 switches are ment for increment decrement, set. After set speed is entered the micro controller drives the motor via motor driver tip122 transistor connected to the port if the port pin is 1 the transistor enters in to the saturation region then the motor start rotating at the rate of specified speed the speed is decided by the duty cycle. initially we are rotating at the rate of 50% duty cycle i.e. 50% on time and 50% off time .The rotation of the motor is detected by the an optical encoder that includes u-shaped octo coupler and sensor with holes the octo coupler generates a square wave corresponding to the no. of ports located on the disk and motor speed.

**3.2 POWER SUPPLY:**

**3.2.1 Description:**

The Power Supply is a Primary requirement for the project work. The required DC power supply for the base unit as well as for the recharging unit is derived from the mains line. For this purpose center tapped secondary of 12V-012V transformer is used. From this transformer we getting 5V power supply. In this +5V output is a regulated output and it is designed using 7805 positive voltage regulator. This is a 3 Pin voltage regulator, can deliver current up to 800 milliamps. Rectification is a process of rendering an alternating current or voltage into a unidirectional one. The component used for rectification is called ‘Rectifier’. A rectifier permits current to flow only during positive half cycles of the applied AC voltage. Thus, pulsating DC is obtained to obtain smooth DC power additional filter circuits required.

**3.2.2 CIRCUIT DIAGRAM:**



100µF/25v

+12v

2200µF/25v

230v / 12v- 0 -12v

500mA Transformer

1N4007 X 2

**FIG.3.1. Block Diagram Of Power Supply**

A diode can be used as rectifier. There are various types of diodes. However, semiconductor diodes are very popularly used as rectifiers. A semiconductor diode is a solid-state device consisting of two elements is being an electron emitter or cathode, the other an electron collector or anode. Since electrons in a semiconductor diode can flow in one direction only-form emitter to collector-the diode provides the unilateral conduction necessary for rectification. The rectified Output is filtered for smoothening the DC, for this purpose capacitor is used in the filter circuit. The filter capacitors are usually connected in parallel with the rectifier output and the load. The AC can pass through a capacitor but DC cannot, the ripples are thus limited and the output becomes smoothed. When the voltage across the capacitor plates tends to rise, it stores up energy back into voltage and current. Thus, the fluctuation in the output voltage is reduced considerable.

**3.3 VOLTAGE REGULATOR**:

The LM 78XXX series of the three terminal regulations is available with several fixed output voltages making them useful in a wide range of applications. One of these is local on card regulation. The voltages available allow these regulators to be used in logic systems, instrumentation and other solid state electronic equipment. Although designed primarily as fixed voltage regulators, these devices can be used with external components to obtain adjustable voltages and currents. The LM78XX series is available in aluminum to 3 packages which will allow over 1.5A load current if adequate heat sinking is provided. Current limiting is included to limit the peak output current to a safe value. The LM 78XX is available in the metal 3 leads to 5 and the plastic to 92. For this type, with adequate heat sinking. The regulator can deliver 100mA output current. The advantage of this type of regulator is, it is easy to use and minimize the number of external components.

The following are the features voltage regulators:

a) Output current in excess of 1.5A for 78 and 78L series

b) Internal thermal overload protection

c) No external components required

d) Output transistor sage area protection

e) Internal short circuit current limit.

**3.4 POSITIVE VOLTAGE REGULATOR:**

The positive voltage regulator has different features like

* Output current up to 1.5A
* No external components
* Internal thermal overload protection
* High power dissipation capability
* Internal short-circuit current limiting
* Output transistor safe area compensation

Direct replacements for Fairchild microA7800 series

|  |  |
| --- | --- |
| Nominal Output Voltage | Regulator |
| 5V | uA7805C |
| 6V | uA7806C |
| 8V | uA7808C |
| 8.5V | uA7885C |
| 10V | uA7810C |
| 12V | uA7812C |
| 15V | uA7815C |
| 18V | uA7818C |
| 24V | uA7824C |

**3.5 SWITCHES:**

The three switches are connected to p1.1,p1.2,p1.3, of micro controller when switch is open the port maintains logic high When the switch is depressed maintains high the logic 0.these 3 switches are pulled to Vcc via 10k resistor the type of switch press to on . In electronics, a switch is an electrical component that can break an electrical circuit, interrupting the current or diverting it from one conductor to another. The most familiar form of switch is a manually operated electro mechanical device with one or more sets of electrical contacts. Each set of contacts can be in one of two states: either 'closed' meaning the contacts are touching and electricity can flow between them, or 'open', meaning the contacts are separated and no conducting.

Since the advent of digital logic in the 1950s, the term has spread to a variety of digital active devices such as transistors and logic gates whose function is to change their output state between two logic levels or connect different signal lines, and even computers, network switches, whose function is to provide connections between different port sin a computer network The term 'switched' is also applied tell communication networks, and signifies a network that is providing dedicated circuits for communication between end nodes, such as the network. The common feature of all these usages is they refer to devices that control a binary state: they are either on or off, closed or open, connected or not connected.

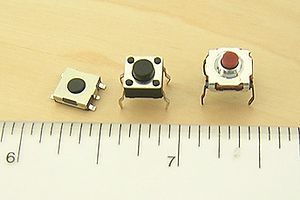
[](http://en.wikipedia.org/wiki/File:Tactile_switches.jpg)

Fig.3.2.. switches

When the wattage being switched is sufficiently large, the electron flow across opening switch contacts is sufficient to ionize the air molecules across the tiny gap between the contacts as the switch is opened, forming a also known as an electric arc. The plasma is of low resistance and is able to sustain power flow, even with the separation distance between the switch contacts steadily increasing. The plasma is also very hot and is capable of eroding the metal surfaces of the switch contacts.

Where the voltage is sufficiently high, an arc can also form as the switch is closed and the contacts approach. If the voltage potential is sufficient to exceed the of the air separating the contacts, an arc forms which is sustained until the switch closes completely and the switch surfaces make contact. In either case, the standard method for minimizing arc formation.

Preventing contact damage is to use a fast-moving switch mechanism, typically using a spring-operated tipping-point mechanism to assure quick motion of switch contacts, regardless of the speed at which the switch control is operated by the user. Movement of the switch control lever applies tension to a spring until a tipping point is reached, and the contacts suddenly snap open or closed as the spring tension is released.

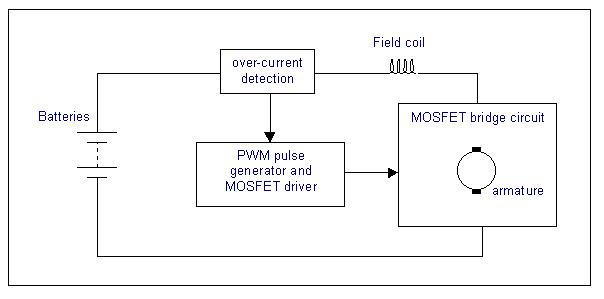
As the wattage being switched increases, other methods are used to minimize or prevent arc formation. Plasma is hot and will rise due air currents. The arc can be quenched with a series of nonconductive blades spanning the distance between switch contacts, and as the arc raises its length increases as it forms ridges rising into the spaces between the blades, until the arc is too long to stay sustained and is extinguished. Extremely large switches enclose the switch contacts in something other than air to increase the resistance against arc formation, such switch contacts in a vacuum, or immersion of the switch contacts in mineral oil.

**3.6 MOTOR AND MOTOR DRIVER:**

The purpose of a motor speed controller is to take a signal representing the demanded speed, and to drive a motor at that speed. The controller may or may not actually measure the speed of the motor. If it does, it is called a Feedback Speed Controller or Closed Loop Speed Controller, if not it is called an Open Loop Speed Controller. Feedback speed control is better, but more complicated, and may not be required for a simple robot design.

Motors come in a variety of forms, and the speed controller's motor drive output will be different dependent on these forms. The speed controller presented here is designed to drive a simple cheap starter motor from a car, which can be purchased from any scrap yard. These motors are generally series wound, which means to reverse them; they must be altered slightly, (see the section on motors).

Below is a simple block diagram of the speed controller. We'll go through the important parts block by block in detail.

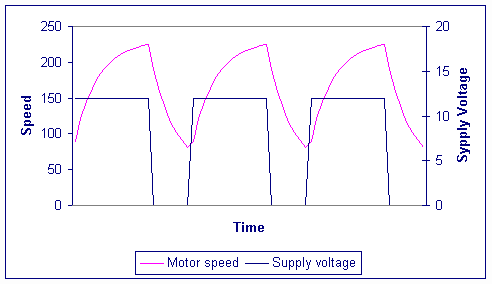


**Fig.3.3. Block Diagram Of Speed Controller**

The speed of a DC motor is directly proportional to the supply voltage, so if we reduce the supply voltage from 12 Volts to 6 Volts, the motor will run at half the speed. How can this be achieved when the battery is fixed at 12 Volts? The speed controller works by varying the average voltage sent to the motor. It could do this by simply adjusting the voltage sent to the motor, but this is quite inefficient to do. A better way is to switch the motor's supply on and off very quickly. If the switching is fast enough, the motor doesn't notice it, it only notices the average effect.

When you watch a film in the cinema, or the television, what you are actually seeing is a series of fixed pictures, which change rapidly enough that your eyes just see the average effect - movement. Your brain fills in the gaps to give an average effect. Now imagine a light bulb with a switch. When you close the switch, the bulb goes on and is at full brightness, say 100 Watts. When you open the switch it goes off (0 Watts). Now if you close the switch for a fraction of a second, and then open it for the same amount of time, the filament won't have time to cool down and heat up, and you will just get an average glow of 50 Watts. This is how lamp dimmers work, and the same principle is used by speed controllers to drive a motor. When the switch is closed, the motor sees 12 Volts, and when it is open it sees 0 Volts. If the switch is open for the same amount of time as it is closed, the motor will see an average of 6 Volts, and will run more slowly accordingly.

As the amount of time that the voltage is *on* increases compared with the amount of time that it is *off*, the average speed of the motor increases. This *on-off* switching is performed by power MOSFET. A MOSFET (Metal-Oxide-Semiconductor Field Effect Transistor) is a device that can turn very large currents on and off under the control of a low signal level voltage. For more detailed information, see the dedicated chapter on MOSFET) The time that it takes a motor to speed up and slow down under switching conditions is dependent on the inertia of the rotor (basically how heavy it is), and how much friction and load torque there is. The graph below shows the speed of a motor that is being turned on and off fairly slowly:



**Fig.3.4.Graph Between Speed And Supply Voltage**

You can see that the average speed is around 150, although it varies quite a bit. If the supply voltage is switched fast enough, it won’t have time to change speed much, and the speed will be quite steady. This is the principle of switch mode speed control. Thus the speed is set by PWM.

**3.7 Optical encoder:**

Optical encoder is a electro mechanical device which provides the most efficient method of digitizing the variable properties of a rotating shaft. The optical encoder's disc is made of glass with transparent and opaque areas. A light source and photo detector array reads the optical pattern that results from the disc's position at any one time .This code can be read by a controlling device, such as a microprocessor, to determine the angle of the shaft .The absolute analog type produces a unique dual analog code that can be translated into an absolute angle of the shaft (by using a special algorithm).

The controller's two channels can be operated independently or combined to set the direction and rotation of a vehicle by coordinating the motors on each side (tank-like steering). The motors may be operated in open or closed loop speed mode. The AX2860 includes inputs for two Quadrate. Encoders up to250kHz and four limit switches, for precise speed and traveled distance measurement .The AX2860 features intelligent current sensing and controlling that will automatically limit each channel's power output to 120A. For higher power application, the product may be ordered in a Single Channel configuration, capable of driving single load up to 240A at 60V.

The controller supports a long list of features, including analog and digital I/Os for accessories and sensors, thermal protection, programmable acceleration, short-circuit protection, input command watchdog and non-volatile storage of configuration parameters. The AX2860 can be reprogrammed in the field with the latest features by downloading new operating software from Robotic' s web site .The AX2860 is built into a compact 9.0"L x 5.5"W x 1.6"H (228mm x 140mm x40mm), robust extruded aluminum case, which also serves as a heat sink for it output power stage. The large fin area ensures sufficient heat dissipation for operation without a fan in most applications. The AX2860 is available now to customers worldwide at $720 in single quantities, complete with cable and PC-based configuration software. Product Information, application examples and software can be downloaded from the company's web site at www.roboteq.com.

**3.8 89C52 MICROCONTROLLER:**

**3.8.1 INRODUCTION**

Micro controller is a true computer on a chip. Microprocessors are intended to be general-purpose digital computers whereas micro controllers are intended to be special purpose digital controllers. Generally microprocessors contain a CPU, memory- addressing units and interrupt handling circuits. Micro controllers have these features as well as timers, parallel and serial I/O and internal RAM and ROM. Like the microprocessor, a microcontroller is a general-purpose device, but one that is meant to read data, and control its environmental based on those calculations. The contrast between a micro controller and a microprocessor is best exemplified by the fact that microprocessors have many operational codes for moving data from external memory to CPU; microcontrollers may have one or two. Microprocessors may have one or two types of bit-handling instructions; micro controllers will have many. The microprocessor is concerned with the rapid movement of code and data from external addresses to the chip; the microcontroller is concerned with rapid movements of bits within the chip. The microcontroller can function as a computer with the addition of no external digital parts; the microprocessor must have many additional parts to be operational. Generally 4-bit microcontrollers are intended for use in large volumes as true 1-chipcomputers.

Typical applications consist of appliances and toys. Eight bit micro controllers represent a transition zone between the dedicated, high volume, 4-bit micro controllers and the high performance, 16 and 32-bit units. Eight bit micro controllers are very useful word size for small computing tasks. 16-bit controllers have also been designed to take the advantage of high level programming languages in the expectation that very little assembly language programming will be done when employing these controllers in sophisticated applications. 32 bit controllers are also used in high speed control and signal processing applications.

**3.8.2 DESCRIPTION**

The AT89C52 is a low-power, high-performance CMOS 8-bit microcomputer with 8K bytes of Flash programmable and erasable read only memory (PEROM). The device is manufactured using Atmel’s high-density nonvolatile memory technology and is compatible with the industry-standard MCS-51 instruction set and pin out. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional nonvolatile memory programmer. By combining a versatile 8-bit CPU with Flash on a monolithic chip, the Atmel AT89C52 is a powerful microcomputer which provides a highly-flexible and cost-effective solution to many embedded control applications

**3.8.3 ON-CHIP MEMORY**

This refers to any memories (Code, RAM or other) that physically exist on the Microcontroller itself. On- Chip memory can be of several types. The 8051 has a bank of 128 bytes if Internal RAM. This internal RAM available and it is also the most flexible in terms of reading, writing, and modifying its contents. Internal RAM is volatile, so when the 8051 is rest this memory is cleared. The first 8 bytes (00h-07h) are “register bank 0”. By manipulating certain SFRs, a program may choose to use register banks 1, 2 or 3. These alternative register banks are located in internal RAM in addresses 08h through 1Fh. Bit memory also lives and is part of internal RAM. The 80bytes remaining of Internal RAM, from addresses 30h through 7Fh,may be used by user variables that need to be accessed frequently or at a high speed. This area is also utilized by the microcontroller as a storage area for the operating stack. This fact severely limits the 8051’s stack since, as illustrated in the memory map, the area reserved for the stack is only 80 bytes and usually it is less since these 80 bytes has to be shared between stack and user.

**3.8.4 EXTERNAL CODE MEMORY**

This is code (or program) memory that resides off-chip. This is often in the form of an external (EPROM). Code Memory is the memory that holds the actual 8051 program that is to be run. This memory is limited to 64K and comes in many shapes and sizes. Code Memory may be found on-chip, either burned in to the microcontroller as ROM or EPROM. Code may also be stored completely off-chip in an external ROM or, more commonly, an external EPROM. Flash RAM is also another popular method of storing program. Various combinations of these memory types may also be used-that is to say, it is possible to have 4K of code memory on-chip and 64K of code memory off-chip in an EPROM. When the program is stored in-chip the 64K maximum is often reduced to 4K, 8K or 16K.This varies depending on the version of the chip that is being used. Each version offers how much ROM/EPROM spacer the chip has. However, code memory is most commonly implemented as off-chip EPROM. This is especially true in low-cost development systems.

**3.8.5 EXTERNAL RAM**

This RAM memory resides off-chip. This is often in the form of standard static RAM or flash RAM.As an obvious of Internal RAM, the 8051 also supports what is called External RAM.As the name suggests, External RAM is any random access memory which is found off-chip. Since the memory is off-chip it is not as flexible in terms of accessing, and is also slower. For example, to increment an Internal RAM location by 1 requires only 1 instruction and 1 instruction cycle. To increment a 1-byte value stored in External RAM requires 4 instructions and 7 instruction cycles. In this case, external memory is 7 times slower. What external RAM loses in speed and flexibility it gains in quantity While internal RAM is limited to 128 bytes (256 bytes with an 8052), the 8051 supports External RAM up to 64K.

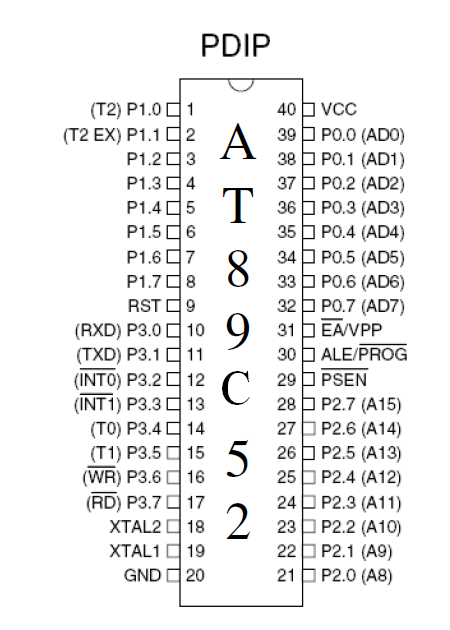
**3.8.7** **FEATURES:**

* Compatible with MCS-51 Products.
* 8K Bytes of In-System Reprogrammable Flash Memory.
* Endurance: 1,000 Write/Erase Cycles.
* Fully Static Operation: 0 Hz to 24 MHz
* Three-level Program Memory Lock.
* 256 x 8-Bit Internal RAM.
* 32 Programmable I/O Lines.
* Three 16-bit Timer/Counters.
* Eight Interrupt Sources.
* Programmable Serial Channel.
* Low Power Idle and Power Down Modes

**3.8.8 PIN DIAGRAM AND ITS DESCRIPTION:**

The microcontroller generic part number actually includes a whole family of microcontrollers that have numbers ranging from 8031to 8751 and are available in N-Channel Metal Oxide Silicon (NMOS) and Complementary Metal Oxide Silicon (CMOS) construction in a variety of package types. with 4Kbytes of Flash Programmable and Erasable Read Only Memory (PEROM). The device is manufactured using Atmel’s high density nonvolatile memory technology and is compatible with the industry standard MCS-51 instruction set and pin out. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional nonvolatile memory programmer. By combining a versatile 8-bit CPU with Flash on a monolithic chip, the Atmel AT89C52 is a powerful microcomputer which provides a highly flexible and cost effective solution to many embedded control applications.

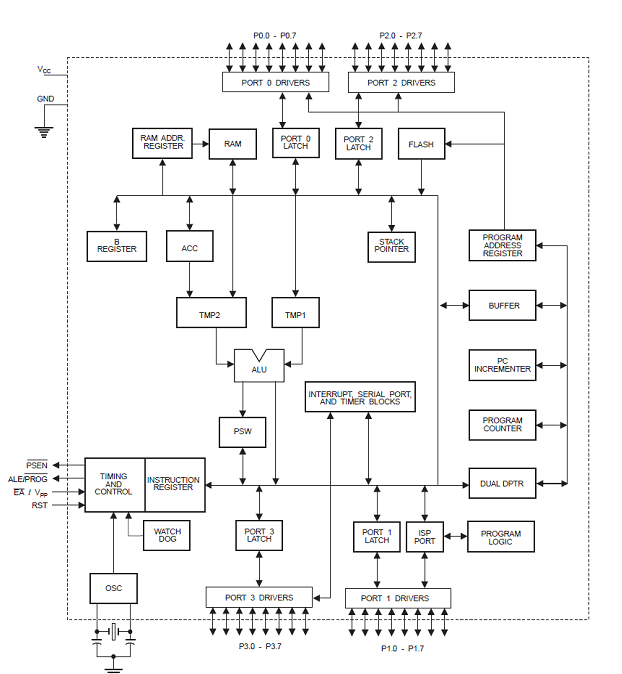
**PIN DIAGRAM:**



**Fig.3.5. Pin Diagram**

The AT89C52 provides the following standard features: 4 Kbytes of Flash, 256 bytes of RAM, 32 I/O lines, two 16-bit timer/counters, five vector two-level interrupt architecture, a full duplex serial port, and on-chip oscillator and clock circuitry. In addition, the AT89C52 is designed with static logic for operation down to zero frequency and supports two software selectable power saving modes. The Idle Mode stops the CPU while allowing the RAM, timer/counters, serial port and interrupt system to continue functioning. The Power down Mode saves the RAM contents but freezes the oscillator disabling all other chip functions until the next hardware reset.

**3.8.8 ARCHITECTURE OF 89C52:**



**Fig.3.6.Architecture of 89C52**

**Port 0:**

Port 0 is an 8-bit open drain bidirectional I/O port. As an output port each pin can sink eight TTL inputs. When 1s are written to port 0 pins, the pins can be used as high-impedance inputs. Port 0 may also be configured to be the multiplexed low order address/data bus during accesses to external program and data memory. In this mode P0 has internal pull-ups. Port 0 also receives the code bytes during Flash programming, and outputs the code bytes during program verification. External pull-ups are required during program verification.

**Port 1:**

Port 1 is an 8-bit bi-directional I/O port with internal pull-ups. The Port 1 output buffers can sink/source four TTL inputs. When 1s are written to Port 1 pins they are pulled high by the internal pull-ups and can be used as inputs. As inputs, Port 1 pins that are externally being pulled low will source current (IIL) because of the internal pull-ups. Port 1 also receives the low-order address bytes during Flash programming and program verification.

Alternate functions of port 1



**Port 2:**

Port 2 is an 8-bit bidirectional I/O port with internal pull ups. The Port 2 output buffers can sink/source four TTL inputs. When 1s are written to Port 2 pins they are pulled high by the internal pull-ups and can be used as inputs. As inputs, Port 2 pins that are externally being pulled low will source current (IIL) because of the internal pull ups. Port 2 emits the high-order address byte during fetches from external program memory and during accesses to external data memory that use 16-bit addresses (MOVX A,@DPTR). In this application it uses strong internal pull-ups when emitting 1s. During accesses to external data memory that uses 8-bit addresses (MOVX A, @RI), Port 2 emits the contents of the P2 Special Function Register. Port 2 also receives the high-order address bits and some control signals during Flash programming and verification.

**Port 3:**

Port 3 is an 8-bit bidirectional I/O port with internal pull ups. The Port 3 output buffers can sink/source four TTL inputs. When 1s are written to Port 3 pins they are pulled high by the internal pull ups and can be used as inputs. As inputs, Port 3 pins that are externally being pulled low will source current (IIL) because of the pull ups. Port 3 also serves the functions of various special features of the AT89C52 as listed below:

Alternate functions of port 3



**3.8.9 RST**:

RST means RESET; 89C52 uses an active high reset pin. It must go high for two machine cycles. The simple RC circuit used here will supply voltage (Vcc) to reset pin until capacitance begins to charge. At a threshold of about 2.5V, reset input reaches a low level and system begin to run.

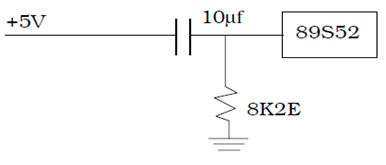


Fig.3.7.Reset Connection

**ALE/PROG:**

Address Latch Enable output pulse for latching the low byte of the address during accesses to external memory. This pin is also the program pulse input (PROG) during Flash programming. In normal operation ALE is emitted at a constant rate of 1/6 the oscillator frequency, and may be used for external timing or clocking purposes. Note, however, that one ALE pulse is skipped during each access to external Data Memory. If desired, ALE operation can be disabled by setting bit 0 of SFR location 8EH. With the bit set, ALE is active only during a MOVX or MOVC instruction. Otherwise, the pin is weakly pulled high. Setting the ALE-disable bit has no effect if the microcontroller is in external execution mode.

**PSEN:**

Program Store Enable is the read strobe to external program memory. When the AT89C52 is executing code from external program memory, PSEN is activated twice each machine cycle, except that two PSEN activations are skipped during each access to external data memory.

**EA/VPP:**

External Access Enable. EA must be strapped to GND in order to enable the device to fetch code from external program memory locations starting at OOOOH up to FFFFH. Note, however, that if lock bit 1 is programmed, EA will be internally latched on reset. EA should be strapped to Vcc for internal program executions. This pin also receives the 12-volt programming enable voltage (Vpp) during Flash programming, for parts that require 12-volt Vpp.

XTAL1: Input to the inverting oscillator amplifier and input to the internal clock operating circuit

XTAL2: Output from the inverting oscillator amplifier.

T2: External count input to Timer/Counter 2, Clock out.

T2EX: Counter 2 capture/reload trigger & direction control.

**3.9 THE ON-CHIP OSCILLATORS:**

Pins XTAL1 and XTAL2 are provided for connecting a resonant network to form an oscillator. The crystal frequency is basic internal clock frequency. The maximum and minimum frequencies are specified from 1to 24MHZ.

Program instructions may require one, two or four machine cycles to be executed depending on type of instructions. To calculate the time any particular instructions will take to be executed, the number of cycles ‘C’,

T = C\*12d / Crystal frequency

Here, we chose frequency as 11.0592MHZ. This is because, baud= 2\*clock frequency/ (32d. 12d [256d-TH1]).The oscillator is chosen to help generate both standard and nonstandard baud rates. If standard baud rates are desired, an 11.0592MHZ crystal should be selected. From our desired standard rate, TH1 can be calculated. The internally implemented value of capacitance is 33 pf.

**

**Fig.3.8.On-Chip Oscillators**

**3.9.1 Program Memory Lock Bits:**

On the chip there are three lock bits which can be left unprogrammed (U) or can be programmed (P) to obtain the additional features .When lock bit 1 is programmed, the logic level at the EA pin is sampled and latched during reset. If the device is powered up without a reset, the latch initializes to a random value, and holds that value until reset is activated. It is necessary that the latched value of EA be in agreement with the current logic level at that pin in order for the device to function properly.

**3.9.2 Program Counter and Data Pointer:**

The 89C52 contains two 16-bit registers: the program counters (PC) and the data pointer (DPTR), Each is used to hold the address of a byte in memory. The PC is the only register that does not have an internal address. The DPTR is under the control of program instructions and can be specified by its 16-bit name, DPTR, or by each individual byte name, DPH and DPL. DPTR does not have a single internal address; DPH and DPL are each assigned an address.

**A & B Registers:**

The 89C52 contains 34 general-purpose, working, registers. Two of these, registers A and B, hold results of many instructions, particularly math and logical operations, of the 89C52 CPU. The other 32 are arranged as part of internal RAM in four banks, B0-B3, of eight registers. The A register is also used for all data transfers between the 89C52 and any external memory. The B register is used for with the A register for multiplication and division operations.

**3.9.3 Flags and the Program Status Word (PSW):**

Flags may be conveniently addressed, they are grouped inside the program status word (PSW) and the power control (PCON) registers.

The 89C52 has four math flags that respond automatically to the outcomes of math operations and three general-purpose user flags that can be set to 1 or cleared to 0 by the programmer as desired. The math flags include Carry (C), Auxiliary Carry (AC), Overflow (OV), and Parity (P). User flags are named F0, GF0 and GF1; they are general-purpose flags that may be used by the programmer

**3.10 LIQUID CRYSTAL DISPLAY:**

In 1968, RCA Laboratories developed the first liquid crystal display (LCD). Since then, LCD’s have been implemented on almost all types of digital devices, from watches to computer to projection TVs .LCD’s operate as a light “valve”, blocking light or allowing it to pass through. An image in an LCD is formed by applying an electric field to alter the chemical properties of each LCC (Liquid Crystal Cell) in the display in order to change a pixel’s light absorption properties. These LCC’s modify the image produced by the backlight into the screen output requested by the controller. Through the end output may be in color, the LCC’s are monochrome, and the color is added later through a filtering process. Modern laptop computer displays can produce 65,536 simultaneous colors at resolution of 800 X 600.

To understand the operation of an LCD, it is easiest to trace the path of a light ray from the backlight to the user. The light source is usually located directly behind the LCD, and can use either LED or conventional fluorescent technology. From this source, the light ray will pass through a light polarizer to uniformly polarize the light so it can be acted upon by the liquid crystal (LC) matrix. The light beam will then pass through the LC matrix, which will determine whether this pixel should be “on” or “off”. If the pixel is “on”, the liquid crystal cell is electrically activated, and the molecules in the liquid will align in a single direction. This will allow the light to pass through unchanged. If the pixel is “off”, the electric field is removed from the liquid, and the molecules with in scatter. This dramatically reduces the light that will pass through the display at that pixel.

In a color display, after the light passes through the liquid crystal matrix, it passes through a color filter (usually glass). This filter blocks all wavelengths of light except those within the range of that pixel. In a typical RGB display, the color filter is integrated into the upper glass colored microscopically to render each individual pixel red, green or blue. The areas in between the colored pixel filter areas are printed black to increase contrast. After a beam of light passes through the color filter, it passes through yet another polarizer to sharpen the image and eliminate glare. The image is then available for viewing.

**3.10.1 INTERFACING LCD TO THE MICROCONTROLLER**:

This is the first interfacing example for the parallel port. We will star with something simple. This example does not use the Bi-directional feature found on newer ports, thus it should work with most, if no all Parallel Ports. It however does not show the use of the status port as an input. So what are we interfacing A 16 Character X 2 Line LCD Module to the Parallel Port. These LCD Modules are very common these days, and are quite simple to work with, as all the logic required running them is on board.

**3.10.2 Features:**

* Interface with either 4-bit or 8-bit microprocessor.
* Display data RAM
* 80 8 bits (80 characters).
* Character generator ROM
* 160 different 5 7 dot-matrix character patterns.
* Character generator RAM
* 8 different user programmed 5 7 dot-matrix patterns.
* Display data RAM and character generator RAM may be
* Accessed by the microprocessor.
* Numerous instructions
* Clear Display, Cursor Home, Display ON/OFF, Curser
* ON/OFF, Blink Character, Cursor Shift, Display Shift.
* Built-in reset circuit is triggered at power ON.



Fig.3.9. LCD

**3.10.3 Pin diagram:**

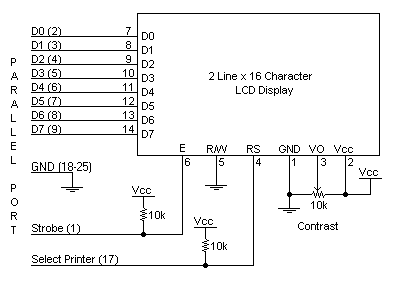


Fig.3.10. Pin Diagram Of Lcd

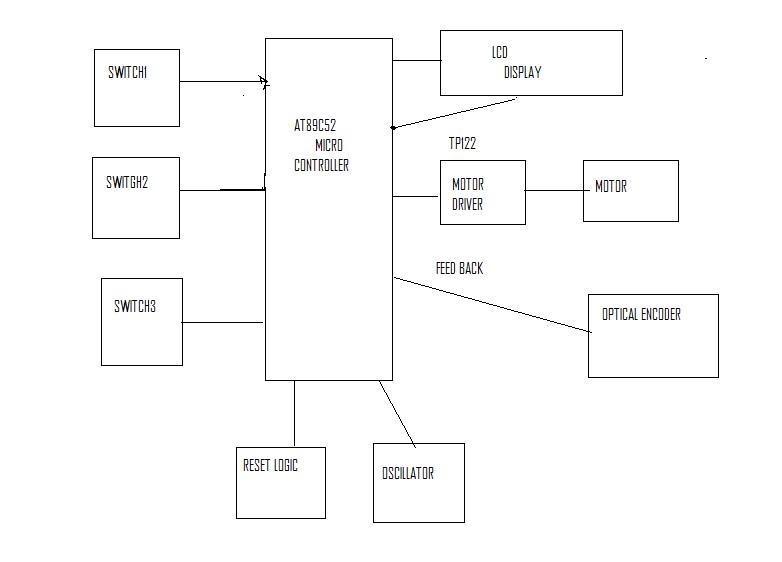
In the above table Vcc and Vss are supply pins and VEE (Pin no.3) is used for controlling LCD contrast. Pin No.4 is Rs pin for selecting the register, there are two very important registers are there inside the LCD. The RS pin is used for their selection as follows. If RS=0, the instruction command code register is selected, allowing the user to send data to be displayed on the LCD. R/W is a read or writes Pin, which allows the user to write information to the LCD or read information from it. R/W=1 when reading R/W=0 when writing. The LCD to latch information presented to its data pins uses the enable (E) pin. The 8-bit data pins, D0-D7, are used to send information to the LCD or read the contents of the LCD’s internal registers. To display letters and numbers, we must send ASCII codes for the letters A-Z, and number 0 -9 to these pins while making RS=1.

**4.BLOCK DIAGRAM**

**CIRCUIT DIAGRAM**

**4. BLOCK DIAGRAM AND CIRCUIT DIAGRAM**

**4.1 BLOCK DIAGRAM:**

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**Fig.4.1.Block Diagram Of D.C Motor Speed Control Using Pwm**

4.2 **CIRCUIT DIAGRAM:**



**Fig.4.2.Circuit Diagram Of D.C Motor Speed Control Using Pwm**

**4.3 EXPLANATION:**

Pulse-width modulation (PWM) or duty-cycle variation methods are commonly used in speed control of DC motors. The duty cycle is defined as the percentage of digital high’ to digital ‘low’ plus digital ‘high ’pulse-width during a PWM period .Fig . 1 shows the 5V pulses with 0%through 50% duty cycle .The average DC voltage value for0% duty cycle is zero; with 25% duty cycle the average value is 1.25V (25%of 5V). With 50% duty cycle the average value is 2.5V, and if the duty cycle is 75%, the average voltage is 3.75Vand so on. The maximum duty cycle can be 100%, which is equivalent to a DC waveform.

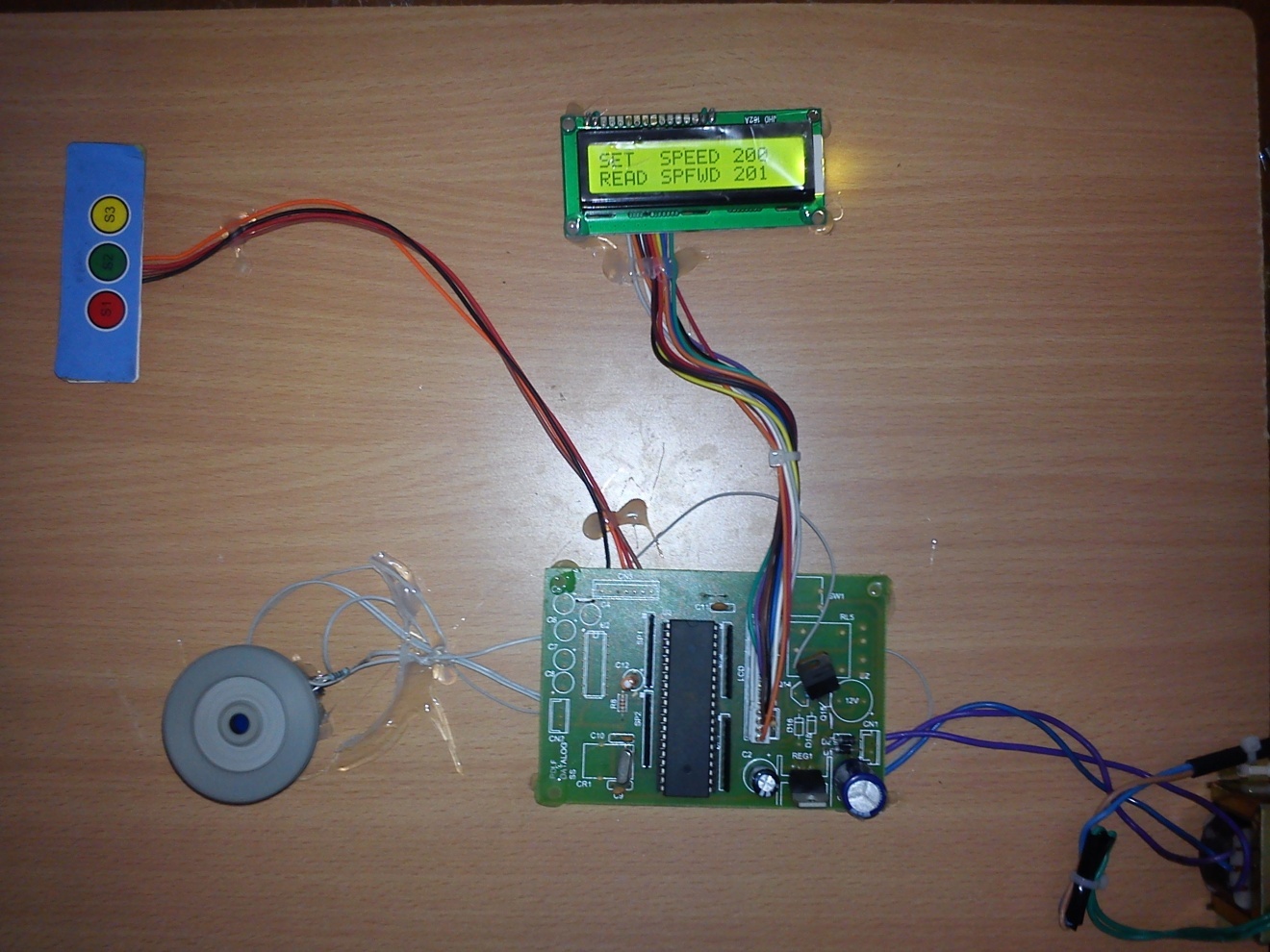
Thus by varying the pulse-width, we can vary the average voltage across a DC motor and hence its speed .The circuit of a simple speed controller for a mini DC motor, such as that used in tape recorders and toys, is shown in Fig. 2.Here N1 inverting Schmitt trigger is configured as an a stable but variable duty cycle . Although the total in-circuit resistance of VR1 during a complete cycle is100 kilo-ohms, the part used during positive and negative periods of each cycle can be varied by changing the position of its wiper contactor obtain variable pulse-width. Schmitt gate N2 simply acts as a buffer/driver to drive transistor T1 during positive in recursion sat its base.

Thus the average amplitude of DC drive pulses or the speed of motor M is proportional to the setting of the wiper position of VR1portmeter. Capacitor C2 serves as a Fig. 1: 5V pulses with 0% through50% duty cycle storage capacitor to provide stable voltage to the circuit.

Thus, by varyingVR1 the duty cycle can be changed from 0% to100% and the speed of the motor from ‘stopped’ condition to ‘full speed in an even and continuous way. The diodes effectively provide different timing resistor values during charging and discharging of timing capacitor C1.The pulse or rest period is approximately given by the following equation: Pulse or Rest period ≈ 0.4 x C1(Farad) x VR1 (ohm) seconds .

Here, use the in-circuit value of VR1 during pulse or rest period as applicable .The frequency will remain constant is given by the equation: Frequency ≈ 2.466/(VR1.C1) ≈ 250Hz (for VR1=100 kilo-ohms and C1=0.1μF)The recommended value of in-circuit resistance should be greater than50 kilo-ohms but less than 2 mega ohms ,while the capacitor value should be greater than 100 Pf.

**5. CIRCUIT OVERVIEW:**

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**5.RESULT**

**CONCLUSION**

**5. RESULT AND CONCLUSION**

**5.1 RESULTS:**

Whenever the supply is on then the motor is rotating ,on that time the optical encoder senses the motor speed and the user sets the set speed and then the motor counts the speed according to that speed .on that time the any disturbance occur to the optical encoder the counter does not count any speed. Here the three switches arte there is for sets the speed and another two is increment and decrement purpose.

**5.2 CONCLUSION:**

The dc motor speed is controlled by using power electronic converter circuit. The PWM technique is used to control the speed of dc motor the speed sensor is used to detect the speed and closed loop control systems is used for pulse circuit. The speed pulse train will be based on required input speed. this circuit is useful to operate the dc motors at required speed.The circuit response time is too low. Hence high reliability can be achieved. The designed circuit was tested for various speed inputs satisfactorily.

**ANNEXURE**

**Microcontroller program:**

**ORG 0**

**LJMP START**

**ORG 0050;**

**THIS IS SPEED CONTROL PROGRAM DT:20-03-2007 LCD PVPSIT ;**

**P2.5 = ENABLE;**

**p2.6 = READ/WRITE;**

**P2.7 = REG INS=0 /DATA=1;**

**P1.4 =MOTOR;**

**P1.5 =MOTOR;**

**50H = DISP LOCATION ADD;**

**51H = SPEED ON TIME;**

**52H = SPEED OFF TIME;**

**53H = SPEED SET VAL;**

**54H = SPEED READ VAL**

**START:**

**CLR P1.4**

**CLR P1.**

**YXZ: MOV 56H,#00H**

**JB P1.1,UXD**

**LCALL DEL1**

**JB P1.1,YXZ**

**MOV 56H,#01H**

**UXD:**

**LCALL LCDINI**

**XX1: LCALL SEC**

**MOV DPTR, #03C0H**

**LCALL TLINE**

**MOV DPTR, #03D0H**

**LCALL BLINE**

**LCALL SSEC**

**MOV DPTR, #03E0H**

**LCALL TLINE**

**MOV DPTR, #03F0H**

**LCALL BLINE**

**LCALL SSEC**

**MOV 50H,#8BH**

**MOV 51H,#7FH**

**MOV 52H,#80H**

**MOV 55H,#00H**

**MOV 53H,#7FH**

**LCALL SDI**

**LCALL SEC**

**MMRR:**

**MOV R0,#00H**

**Y1:**

**LCALL DEL1**

**JB P1.1,Y1**

**LCALL INCR**

**MOV 50H,#8BH**

**CLR A**

**MOV A,53H**

**MOV 55H,A**

**LCALL SDIS**

**LCALL SEC**

**U1:**

**JB P1.2,U\**

**LCALL DEL1**

**JB P1.2,U1**

**LCALL DECR**

**MOV 50H,#8BH**

**CLR A**

**MOV A,53H**

**MOV 55H,A**

**LCALL SDIS**

**LCALL SEC**

**U2:**

**JB P1.3,Y1**

**LCALL DEL1**

**JB P1.3,U2**

**TY1:**

**JB P1.3,TY1**

**LCALL DEL1**

**;\*\*\*\*\*\*\*\*\*\*\*\***

**DB #32H**

**DB #35H**

**DB #34H**

**;------------------**

**;\*\*\*\*\*\*\*\*\*\*\*\***

**DB #32H**

**DB #35H**

**DB #35H**

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